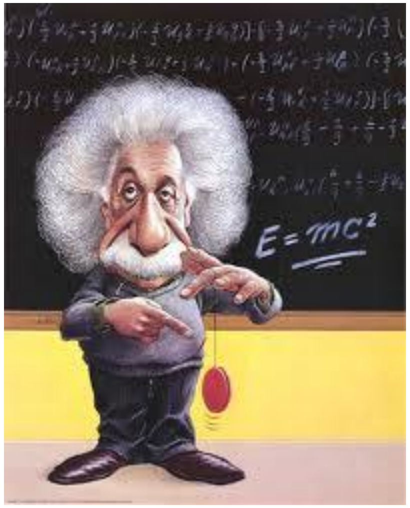
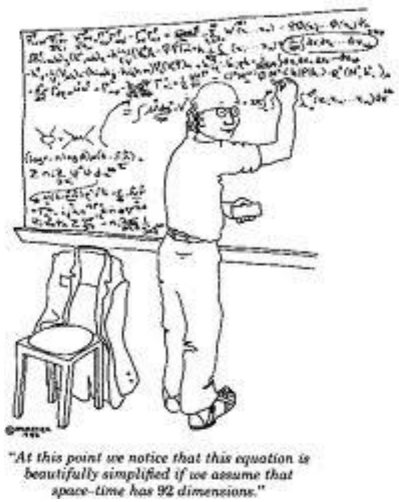
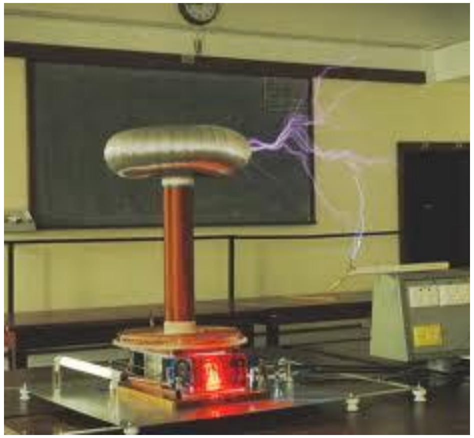
PHYSICS!!! (SPH3U)

Key concepts:

- physics
- scientific inquiry
- observation
- qualitative
- quantitative
- metric
- precision
- accuracy







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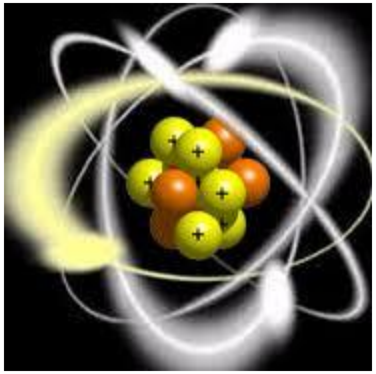
- involves the study of the physical world



$E=mc^2$

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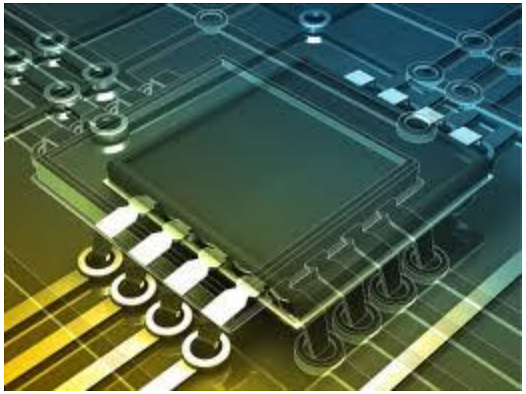
- Today...



PHYSICS!!! (SPH3U)

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- Observations
  - qualitative ("a bird is gliding to its nest")
  - quantitative ("the car travelled at 60km/hr")

↘ quantity – number

- Models (representations) – Equations
  - Graphs
  - Descriptions
  - Table of Values
- Theories (validated by many scientists)

Einstein's Theory of Relativity

$E = mc^2$

The Metric System

Key concepts:

- physics
- scientific inquiry
- observation
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- quantitative
- metric
- precision
- accuracy

- started a couple hundred years ago in France...needed a standard system that everyone could agree on
- 1970 – "metrication of Canada"
- most measurements metric by early 1980s
- 3 core measurements:
  - length (m)
  - mass (kg)
  - time (s)

Metric Prefixes

Key concepts:
- physics
- scientific inquiry
- observation
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- accuracy

- often use prefixes in front of base units
- important to always CONVERT to BASE UNITS!

Factor	Prefix	Symbol
10^9	giga	G
10^6	mega	M
10^3	kilo	k
10^0	---	---
10^{-2}	centi	c
10^{-3}	milli	m
10^{-6}	micro	µ
10^{-9}	nano	η

Precision and Accuracy

Key concepts:

- physics
- scientific inquiry
- observation
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- accuracy

- **Precise** - after taking a lot of measurements, you notice that they are all very close to each other.
- **Accurate** - after taking a lot of measurements, you find they agree with the true value.

Precision and Accuracy

Key concepts:

- physics
- scientific inquiry
- observation
- qualitative
- quantitative
- metric
- precision
- accuracy

Example 1: You perform an experiment to measure the temperature at which water boils.

67^0C	68^0C	68^0C	65^0C	66^0C

- these values are precise

(they are almost the same, they agree with each other)

- they are not accurate

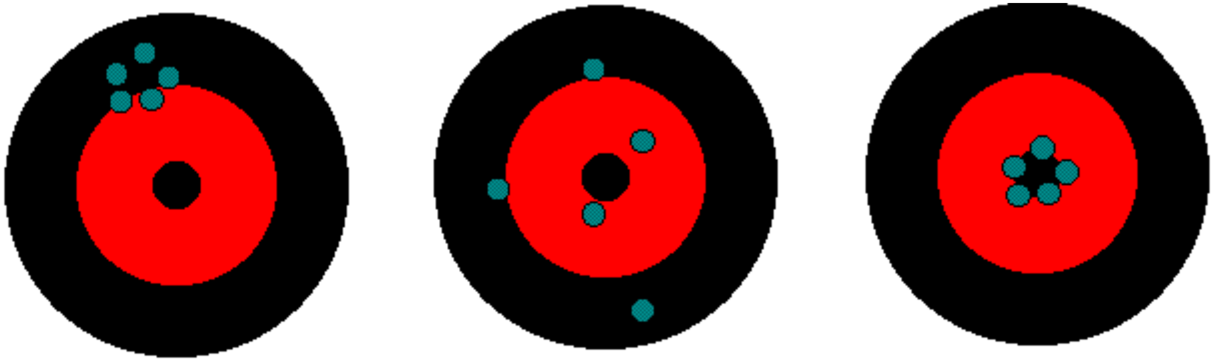
- they would have to be at about 100°C, the accepted value, to be accurate

Precision and Accuracy

Key concepts:

- physics
- scientific inquiry
- observation
- qualitative
- quantitative
- metric
- precision
- accuracy

Example 2: I ask you to throw five darts at the centre of a dart board.



Good Precision	Poor Precision	Good Precision
Poor Accuracy	Poor Accuracy	Good Accuracy

Significant Digits (Sig Digs)

Key concepts:

- significant digits
- error
- manipulating equations

Exact Numbers

- all counted quantities are exact and have infinite sig digs
- example: 32 red cars on a lot; pi

Significant

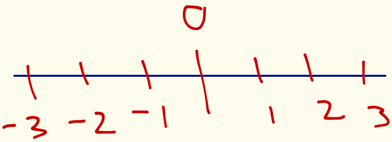
- numbers 1 to 9 are **always** significant
- example: 259.49 (5 sig digs)
- any zeros between two non-zeros
- example: 104 (3 sig digs)
- any zero to the right of **both** a decimal and a non-zero
- example: 0.0030 (2 sig digs)
- ALL digits in scientific notation

5.2×10^{3}

5200

5.2×10^{-3}

0.0052



2×10^{5}

↖ 1 significant digit

5.336×10^{7}

↖ 4 sig digs

SIGNIFICANT DIGITS (SIG DIGS)

Key concepts:

- significant digits
- error
- manipulating equations

NOT Significant

- leading zeros
- example: 0.00071 — 2 sig digs

- trailing zeros
- example: 2800 — 2 sig digs

***if zeros are meant to be sig digs, the number must be written as

2.800×10^4 — 4 sig digs

Rounding and Sig Digs

Key concepts:

- significant digits
- error
- manipulating equations

Adding and Subtracting

- check which number is the **least precise** (least numbers after decimal)
- use that many decimals in your final answer
- **example**:

4.0 + 12.32 + 2.03456 = 18.35456

Final answer = **18.**4

1 decimal place

Rounding and Sig Digs

Key concepts:

- significant digits
- error
- manipula[...] equation[...]

4.123
4.12
4.1

9.786
9.79
9.8

<u>Multiplying and Dividing</u>

- check which number has the fewest sig digs
- round answer so it has this many sig digs

NOTE:

- if digits dropped are less than 5, remaining digit is unchanged
- if digits dropped are greater than 5, remaining digit is increased
- if digit dropped is exactly 5, remaining digit is rounded up to the **nearest even number**

8.750	6.450
8.8	6.4

Round to 2 sig digs

6.49
= 6.5

6.51
= 6.5

6.501
= 6.5

6.5|51
= 6.6

6.75
= 6.8

6.65
= 6.6

6.651
= 6.7

Error

Key concepts:

- significant digits
- error
- manipulating equations

- Error = difference between an observed value and the accepted value
- percent error is a measure of **accuracy**

percent error = lexperimental value – accepted valuel
accepted value

- **example**: you measure a pencil to be 102 mm, but the manufactured measures it to be 104mm. Find the %error.

Error

Key concepts:

- significant digits
- error
- manipulating equations

- percent difference is a measure of **precision**
- tells you how far apart your measurements are

$$\textit{percent difference} = \frac{\textit{difference in measurements}}{\textit{average measurement}}$$

- example: you measure the length of a ramp twice and get 1.15m and1.13m. Determine the percent difference between your values.

MANIPULATING EQUATIONS

Key concepts:

- significant digits
- error
- manipulating equations

- rearrange equation so the unknown value is on one side of the equation
- TWO RULES:

1. **To move something to the other side, just do the opposite math operation to it.**
2. **If you do it to one side, do it to the other.**

Manipulating Equations

Key concepts:

- significant digits
- error
- manipulating equations

- example: Solve for *m*

$$F=ma$$

$$\frac{F}{a} = \frac{ma}{a}$$

$$\frac{F}{a} = m$$

- example: Solve for v_1

$$v_2^2 = v_1^2 + 2ad$$

$$v_2^2 - 2ad = v_1^2 + 2ad - 2ad$$

$$\sqrt{v_2^2 - 2ad} = \sqrt{v_1^2}$$

$$\sqrt{v_2^2 - 2ad} = v_1$$

HOMEWORK!!!

Key concepts:

- physics
- scientific inquiry
- observation
- qualitative
- quantitative
- metric
- precision
- accuracy

- CIS SIGNED
- Safety Forms
- Lab Fee

- make sure you understand all key concepts
- WS#1
- Worksheet 0.1
- Worksheet 0.2